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AN ANALYSIS OF FOOD STAMP REDEMPTIONS

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The research provides theoretical and statistical models of the food stamp redemption process. The existence of a lag structure in the use and redemption of food stamps is also investigated. The results suggest that food stamps are used by recipients within the month they are received. However, there appears to be some lag in the redemption of the stamps by the Federal Government, probably the result of lags in the banking system. The research also shows that a very small percentage of stamps are not used and redeemed at some time.

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PREFACE

The research reported in this bulletin attempts to design and estimate statistical models useful in developing a better understanding of the U.S. Department of Agriculture's food coupon redemption process. The research was undertaken largely at the request of and partial funding from the Department's Food and Nutrition Service (FNS). The report will be of primary interest to Food Stamp Program managers. Public and private researchers also may be interested in the information.

CONTENTS

	Page
Summary	iv
Introduction	1
Food Coupon Redemption	2
U.S. Total	2
Plotting Issuance, Redemptions, and Liabilities	3
Statistical Results	9
Explanatory Models	9
Lag Identification	11
Results	12
Forecast Models	16
References	22

SUMMARY

This study provides a means of monitoring the U.S. Department of Agriculture's food stamp redemption account. If the models developed in the study had been used on a monthly basis to forecast food coupon redemptions and if deposits in the account had been based upon the predicted redemptions, the size of the monthly balance could likely have been reduced. A balance of approximately 25 percent of monthly redemptions before the elimination of the purchase requirement would have been adequate to cover all cases where the model underestimated actual redemptions.

In terms of actual Government expenditures (monthly redemptions minus cash deposits), the 25-percent rule would have been adequate to meet all but one circumstance where the model underestimated actual Government liabilities. Thus, if monthly bonus issuance continues at about $400 million per month, use of the models would appear to permit maintenance of a redemption account balance of about $100 to $150 million.

An Analysis of Food Stamp Redemptions

*William T. Boehm, Mike Belongia, Masao Matsumoto**

INTRODUCTION

The Food Stamp Program (FSP) has grown substantially since it became part of permanent legislation in 1964. In July 1970, about $135 million in coupons were issued to 7 million program participants. Five years later, participation exceeded 19 million, and the value of coupons issued each month reached $709 million. A growth spurt in early 1976, related primarily to the depressed economy, brought coupon value to $771 million in March of that year. Program activity and issuance then stabilized at about 17 million participants and $690 million in monthly coupon issuance. Such variations in the level of coupon activity, coupled with the very rapid growth in total value of coupon issuance, complicate attempts to efficiently deal with program operations.

A major management activity involves coupon redemption. Adequate funds must be transferred on a timely basis from congressional appropriations to a redemption account held by the U.S. Department of Agriculture's Food and Nutrition Service (FNS) in order to cover the Government's food stamp liability. The timing of such transfer is critical, since a potential interest liability is assumed when funds are actually deposited in the redemption account. Appropriations, of course, represent only a line of credit or an authorization to spend.

The administrative task is complicated because there likely are lags in coupon use by participants and the eventual request for redemption by agents of the Federal Reserve. Management of the redemption account, therefore, implies the ability to forecast both coupon loss (or nonuse) and the appropriate lag structure involved in the redemption process.

Providing answers to four questions served as the research objectives of this investigation.

1. What is the recent history of the Food Stamp Program with regard to monthly values for coupon issuance and redemptions?
2. What are the steps of the coupon redemption process?
3. What is the lag structure involved in the coupon redemption process?
4. Can the steps of the coupon redemption process be applied to forecasting the key measures of program activity?

This report includes a historical record of monthly dollar values for the key measures of FSP activity--food coupon issuance and redemption. These data provide the basis for the estimation of a five-equation model describing the process of food stamp redemptions. This process begins with coupon issuance, is followed by the use of stamps by FSP participants, and concludes when the used food coupons are redeemed by the U.S. Treasury.

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This discussion also includes the search for a lag structure between the use of a food coupon and that coupon's movement to the next step in the redemption process. The descriptive model then is modified to facilitate its use in forecasting dollar values for coupon issuance, redemptions, and the Federal liability in backing the value of the issued food stamps.

The data description presented will be of interest to those seeking a brief summary of FSP activity. The models used to describe the redemption process and to forecast dollar values for its major components will be of interest to Food Stamp Program administrators and to researchers involved with either the FSP or the general question of coupon redemptions.

FOOD COUPON REDEMPTION

The coupon redemption process involves a series of coupon-cash transfers, each having its own FNS reporting requirement. 1/ Coupons are currently issued through FNS field offices to over 13,000 local stamp vendors. These vendors include banks, government agencies, and others authorized by the particular State agency responsible for operation of the FSP. It is at this point, but likely after some lag, that stamps are issued to program participants. In return for the coupons, participants surrender the cash requirement (if any) and their purchase authorization card, the signed card being proof of issuance. Vendors then deposit the cash purchase requirement. The deposit slip becomes proof of deposit. The value of coupons distributed but not purchased by program participants is called bonus issuance. Thus, the total value of issuance includes food coupons purchased by participants and free or bonus coupons.

Once stamps are in the possession of recipients, they may be used for food purchases. After the coupons are used, retailers deposit them with their banks. The deposit slips are fowarded to an FNS data center and are recorded as redeemed. For purposes of this report, this interim redemption is referred to as grocery store to bank redemptions. The stamps are then cleared through the banking system and, ultimately, are counted and destroyed at a Federal Reserve district bank. Once the coupons reach the Federal Reserve bank, the Treasury Department is notified. At this point, the redeemed amount is deducted from the FNS redemption account. Verification of these deductions is sent to FNS. The verifications, however, often are not received by FNS until several months after the actual deductions have been made.

U.S. Total

Fiscal-year data on coupon issuance and Federal Reserve requests for redemption are shown in table 1. Monthly data on coupon store to bank redemptions and Federal Reserve to Treasury redemptions are shown in table 2. From July 1972 to July 1977, $32,890.6 million in coupons were issued to program participants. By July 1977, the U.S. Treasury had redeemed $32,716.4 million, 99.5 percent of the stamps issued. Apparently then, very few stamps issued are never redeemed. However, coupon redemptions appear to lag their issuance date. During the period of rapid growth (fiscal year 1974, in particular), redemptions averaged about 3 percent less than issuance. In fiscal year 1976, after this growth period had ended, stamp redemptions actually exceeded issuance.

1/ See references at the end of this report for a more complete discussion of the coupon redemption process.

Table 1--Summary of food stamp issuance and redemption

Fiscal year	Stamp issuance	Federal Reserve requests for redemption	
	------- Million dollars	-------	Percent
1973	3,883.95	3,851.40	99.2
1974	4,727.45	4,627.80	97.9
1975	7,265.64	7,145.96	98.4
1976 1/	10,778.28	10,797.22	100.2
1977 2/	6,235.26	6,294.06	100.9
Total	32,890.58	32,716.44	99.5

1/ July 1, 1975, to September 30, 1976.
2/ October 1, 1976, to June 30, 1977.

Available data for fiscal 1977 also support the contention that stamp issuance tends to be somewhat seasonal: higher in the fall and winter months and lower in the spring and summer. If there is a lag in redemptions within a year, one would expect reported redemptions to be relatively lower in the fall and winter and higher in the spring and summer. Data for fiscal year 1977 are complete only through June. Stamp redemptions through February 1977 were 97.5 percent of issuance for the fall and winter months. If the above assumption is correct, redemptions may exceed issuance in the latter months of the year, and issuance and redemptions will be about equal for the year.

Plotting Issuance, Redemptions, and Liabilities

Figure 1 is a plot of monthly coupon issuance relative to the monthly requests for coupon redemption. The data show there is substantially more variability in month-to-month redemptions than in coupon issuance. Further, the data plot indicates the three rather distinct periods in program activity. The first period, from July 1970 to about December 1973, might best be described as one of slow growth. The second phase, from January 1974 through March 1975, was a period of very rapid growth. The last phase, from April 1975 to July 1977, was a period of rather stable issuance, but it also had the greatest variability in month-to-month Federal Reserve redemptions.

Figure 2 plots monthly grocery store to bank and Federal Reserve to Treasury redemptions. The data show that there is substantially more variability in the Federal Reserve to Treasury redemptions throughout the series and particularly since January 1975. Average redemptions by month from that date were $705 million. The standard deviation, however, was about $39.5 million; that is, about two-thirds of all monthly redemptions would be at least $665.5 million, but not more than $744.5 million. The data since November 1975 also indicate that the monthly deviations are substantial. Through June 1977, the requests for redemptions averaged $720 million, but the number varied roughly in a $197 million band.

Figure 3 plots monthly Government payments relative to the bonus issuance. Although the Government is liable for all coupons issued, its monthly liability is

Table 2--Food stamp issuance and redemptions, 1972-77

Year and month	Stamp issuance	Grocery store to bank		Federal Reserve to Treasury	
		Redemptions	Percentage of issuance	Redemptions	Percentage of issuance
	-- Million dollars --		Percent	Million dollars	Percent
1972:					
April	284.09	300.57	105.80	263.66	92.8
May	292.83	290.10	99.05	299.59	102.3
June	293.15	261.88	89.33	298.68	101.9
July	309.61	326.53	105.46	279.72	90.3
August	315.74	335.21	106.16	332.66	105.4
September	312.65	243.55	77.89	291.05	93.1
October	315.83	338.35	107.13	314.94	99.7
November	319.37	301.58	94.42	306.68	96.0
December	323.68	318.80	98.48	291.89	90.2
1973:					
January	330.33	342.95	103.82	368.79	111.6
February	330.32	312.99	94.75	305.72	92.6
March	336.20	344.97	102.60	364.97	108.6
April	333.79	316.32	94.76	335.92	100.6
May	331.96	322.17	97.04	340.44	102.6
June	324.47	318.68	98.21	318.62	98.2
July	333.32	330.91	99.27	328.19	98.5
August	340.37	309.14	90.82	356.42	104.7
September	333.12	342.37	102.77	304.12	91.3
October	345.33	347.24	100.55	352.56	102.1
November	352.23	311.38	88.40	341.39	96.9
December	354.11	339.67	95.92	327.07	92.4
1974:					
January	429.88	430.31	100.10	432.92	100.7
February	434.43	391.87	90.20	384.01	88.4
March	451.80	478.29	105.86	469.58	103.9
April	458.96	431.58	94.03	461.32	100.5
May	449.62	417.37	92.82	455.72	101.4
June	444.28	438.23	98.63	414.50	93.3
July	485.65	485.91	100.05	493.74	101.7
August	497.49	467.84	94.04	496.80	99.9
September	504.69	488.21	96.73	460.57	91.3
October	532.19	497.73	93.52	559.39	105.1
November	570.15	558.53	97.96	495.28	86.9
December	607.50	570.33	93.88	569.58	93.8

Continued--

Table 2--Food stamp issuance and redemptions, 1972-77--Continued

Year and month	Stamp issuance	Grocery store to bank		Federal Reserve to Treasury	
		Redemptions	Percentage of issuance	Redemptions	Percentage of issuance
	--- Million dollars ---		Percent	Million dollars	Percent
1975:					
January	646.08	606.01	93.79	680.57	105.3
February	662.83	614.10	92.64	582.70	87.9
March	687.81	731.43	106.34	656.02	95.4
April	691.39	689.44	99.71	748.90	108.3
May	691.04	716.59	103.69	644.26	93.2
June	688.82	645.44	93.70	758.15	110.1
July	709.12	718.90	101.37	665.99	93.9
August	710.18	717.73	101.06	583.72	82.2
September	704.48	715.13	101.51	905.04	128.5
October	714.85	670.21	93.75	535.90	75.0
November	689.95	719.51	104.28	788.05	114.2
December	727.44	690.73	94.95	734.08	100.9
1976:					
January	742.38	788.89	106.26	782.06	105.3
February	740.00	712.73	95.43	697.59	94.3
March	770.83	784.47	103.06	835.22	108.4
April	742.28	740.37	100.03	734.49	99.0
May	716.91	766.80	106.36	678.72	94.7
June	722.74	703.29	99.30	765.13	105.9
July	701.69	737.25	104.85	690.67	98.4
August	703.46	667.99	95.23	712.79	101.3
September	681.97	681.42	99.74	687.77	100.9
October	682.32	715.02	105.36	666.02	97.6
November	690.86	656.72	94.70	637.97	92.4
December	691.44	683.62	98.35	758.96	109.8
1977:					
January	692.89	751.41	108.79	700.49	101.1
February	739.20	685.32	92.36	645.24	87.3
March	711.97	720.96	102.97	828.43	116.4
April	692.92	732.51	106.04	662.60	95.6
May	672.18	687.20	99.86	669.67	99.6
June	661.48	624.16	91.89	724.68	109.6

Actual Food Stamp Issuance and Redemptions

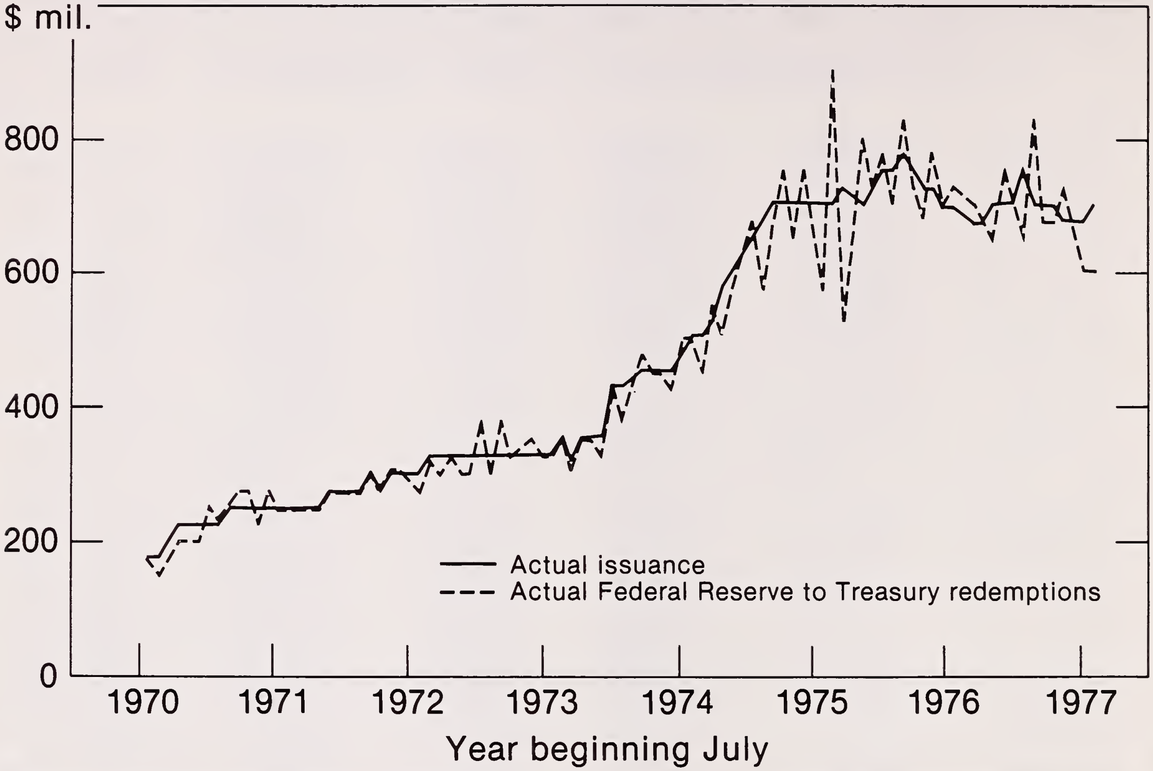

Figure 1

Actual Bank and Treasury Food Stamp Redemptions

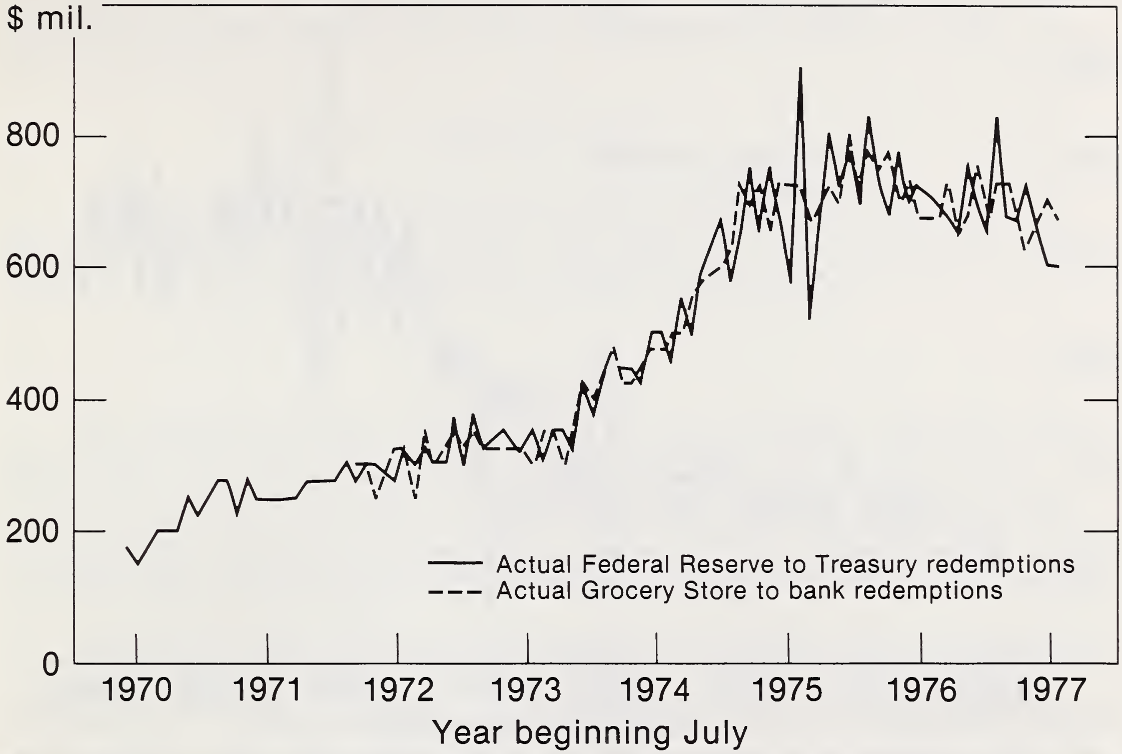

Figure 2

USDA Obligations and Bonus

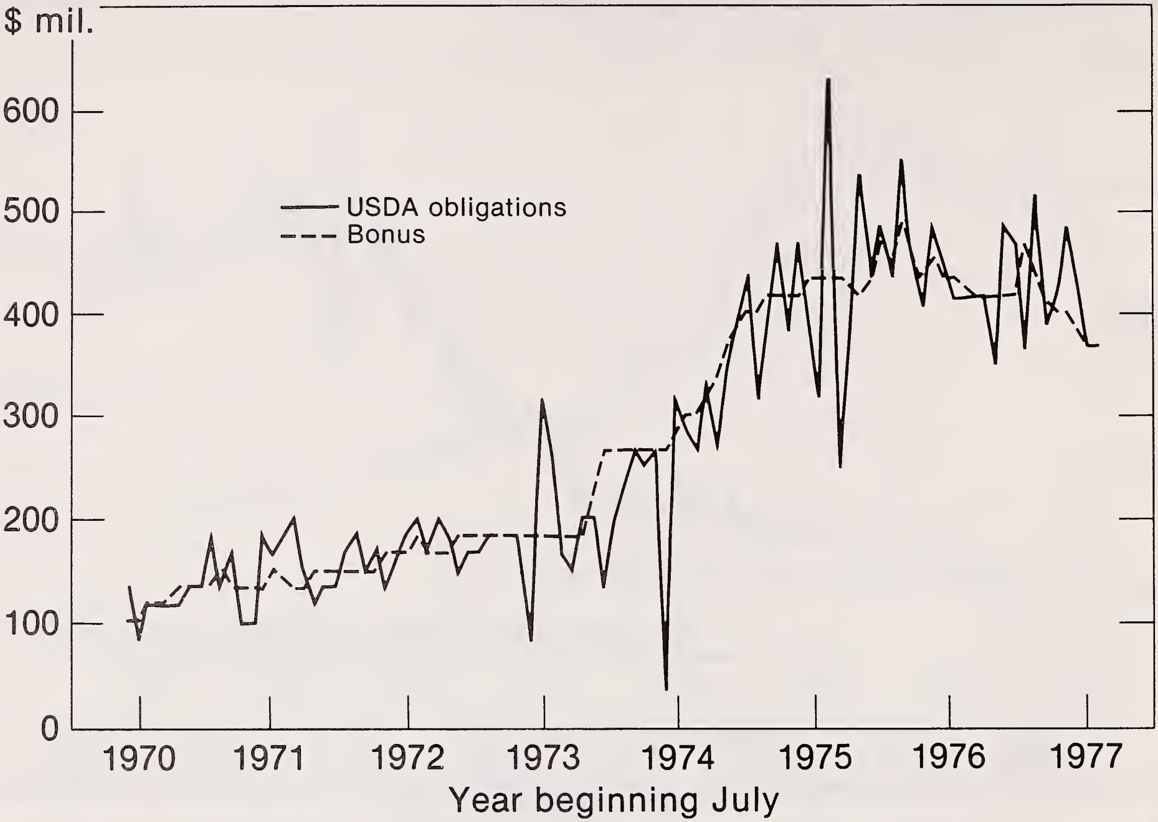

Figure 3

reduced by the amount of the monthly cash deposit--the amount of cash that participants surrender in order to obtain the monthly allotment of coupons.

To obtain an estimate of the monthly variability in actual Government liabilities, monthly cash deposits were subtracted from monthly coupon redemptions. This plot, therefore, provides a first approximation of what the monthly Government payments would have been in the absence of the purchase requirement, assuming the same level of participation and bonus issuance. This issue is addressed more completely in the following section.

STATISTICAL RESULTS

Before statistical models can be constructed to explain the monthly variations in food stamp redemptions, the conceptual framework for this analysis must be developed. Concentrating on the variables that affect the dollar value of the food stamps at any step of this process and at a moment in time should permit the construction of valid statistical models which reflect these phenomena.

Explanatory Models

The redemption process, of course, begins with coupon issuance. The dollar value of monthly issuance is likely affected by: (1) the cost of food in terms of the Thrifty Food Plan--as food costs rise, the dollar value of issuance would also be expected to rise, (2) the number of eligible participants--as more people participate in the program, the dollar value of issuance would be expected to increase, and (3) program rules--changes in the program and its guidelines likely affect issuance by altering either the value of the stamp allotment or the ease with which those eligible can participate in the program.

Measures for each of these variables often are not available, and surrogates must be used to reflect the influences of these variables. For instance, the number of participants should be a function of the base number of people potentially eligible to participate. As most participants do not hold jobs, the level of unemployment (EMP_t) in the domestic work force should capture the basic changes in the number of eligibles. To reflect changes in the relative costs of food over time, the Consumer Price Index for food items (CPI_{F_t}) was selected. To measure the effects of changes in program rules, the value of a stamp issuance in the previous month (ISS_{t-1}) was chosen. These factors then represent the component parts of a model representing the first step in the process of coupon redemption:

$$[1] \quad ISS_t = f(EMP_t, CPI_{F_t}, ISS_{t-1})$$

where:

ISS_t = the dollar value of coupon issuance in the current month, t,

EMP_t = the rate of unemployment in the civilian work force in the current month, t,

CPI_{F_t} = the Consumer Price Index for food items in the current month, t, and

ISS_{t-1} = the dollar value of issuance during the previous month, t-1.

Once program participants receive food stamps, they may use them in grocery stores to purchase food. Stores accept the coupons as cash and deposit them in banks. This intermediate redemption at the local bank level is the next step in tracing the overall redemption process. Isolating the bank redemptions (GS) in the current month should give a partial breakdown indicating how quickly program participants use the coupons for the purchases of food. That is, for each dollar of stamps issued, how many cents of that dollar are spent and redeemed within the month of issuance?

This initial redemption should depend on at least two factors: (1) the value of coupons issued, and (2) the amount of time available to spend the coupons. Since participants can only spend the coupons they have been issued, the value of stamp issuance (ISS) should affect the value of local redemptions. Food sales (FS) should represent the time available to use the coupons, since variations in coupon use are likely related to variations in food sales generally. These relationships yield:

[2] $GS_t = f(ISS_t, FS_t)$

where:

GS_t = the dollar value of food stamps redeemed at local banks in the current month, t,

ISS_t = the dollar value of issuance in the current month, t,

FS_t = the dollar value of food sales for the current month, t.

Once the retailers have deposited the coupons, bankers forward them to one of the Federal Reserve district banks where they are counted and destroyed. The Federal Reserve district banks then notify the U.S. Department of Treasury, reporting the value of stamps redeemed.

The monthly value of stamps redeemed at the Federal Reserve level is the primary concern of this report. This dollar figure: (1) represents the Government's actual food stamp payment liability (minus cash deposits), and (2) helps determine the nature of whatever lag structure may be associated with coupon use by participants and redemption by the banking system.

The variation of monthly redemption at this step should be affected by forces similar to those affecting coupon deposits by grocery retailers. However, since Federal Reserve district banks can only redeem the coupons that have been processed by their member banks, the value of retailer deposits, not stamp issuance, should be considered as the primary variable. In addition, a variable must be included to represent the variability in time available for banks in the system to redeem the stamps. The coupon redemption process is then completed by the equation:

[3] $R_t = f(GS_t, GS_{t-1}, BA_t)$

where:

R_t = the value of coupon redemptions at the Federal Reserve in the current month, t,

GS_t = the value of coupon redemptions at local banks in the current month, t,

GS_{t-1} = the value of coupon redemptions at local banks in the previous month, t-1, and

BA_t = the number of banking days in the current month, t.

Two auxiliary pieces of information are needed to complete the statistical representation of the coupon redemption process. Models to explain monthly variations in both cash deposits and Government liability (Federal Reserve redemptions minus cash deposits) were developed. Monthly cash deposits were thought to be influenced by the same variables that influence grocery store deposits. That is, the amount of cash obtained through the sale of food coupons and then deposited in banks would be dependent upon the level of issuance in the current month. Also, since these deposits also work their way through the banking system, the level of banking activity in that month was expected to influence the recording of such deposits. These factors yielded the model:

[4] $C_t = f(ISS_t, BA_t)$

where:

C_t = the value of cash deposits from food stamp purchases in the current month, t,

ISS_t = the dollar value of issuance in the current month, t, and

BA_t = the number of banking days in the current month, t.

Finally, all of the relationships discussed above ultimately combine to yield the Government monthly liability to redeem the food stamps presented. As previously mentioned, money for such redemption is maintained in an account managed by FNS.

The close relationship of the liability to behavioral patterns described in the other links in the redemption chain led to the selection of variables very similar to those chosen in earlier models.

At first glance, the liability would appear to be most closely related to the value of issuance and the value of stamps redeemed by grocery stores. However, because the liability is offset, in part, by cash deposits, the liability can be modeled as a function of bonus issuance. The value of bonus in month t-1 is included to reflect the lag in the redemption process. The number of banking days in the month is again included to capture variations in banking activity. The payment liability model is then:

[5] $P_t = f(RB_t, RB_{t-1}, BA_t)$

where:

P_t = the dollar value of the Government liability in month t,

RB_t = the value of bonus stamps issued in the current month, t,

RB_{t-1} = the value of bonus stamps issued in the previous month, t-1, and

BA_t = the number of banking days in the current month, t.

Lag Identification

A hypothesized lag structure has been referred to throughout the foregoing discussion. For instance, program participants may not spend all of their coupons in the month they receive them. At the next step, either grocery stores or local banks may, for any number of reasons, only process a portion of the stamps they receive. Once the appropriate lag structure is identified, more accurate forecasts of monthly coupon redemption can be made. Identification of the lag structure is a statistical rather than a conceptual issue. That is, the conceptual framework only indicates that issuance should affect coupon deposits at local banks. However, if participants do not use all of their coupons in the month they are issued, the value of issuance in prior months may also affect the value of local redemptions in the current month.

Preliminary statistical testing was conducted in an attempt to verify the existence of lags in the coupon use and redemption processes. The results of these tests are included in table 3. Basically, these models tested the use of 1-, 2- and 3-month lags for coupon issuance, grocery store deposits, coupon redemptions, and cash deposits. These tests provide the basis for the inclusion of some of the independent variables used in the equations discussed below.

Results

Parameter estimates for the variables in these five equations were obtained using ordinary least squares regression. Monthly observations for all variables from July 1970 through June 1977 were used for the analysis. Data for the study were developed from account records maintained by FNS.

Results of the estimation are summarized in table 4. In general, the variables in each of the models were able to account for substantial amounts of the total variation in each dependent variable vector. There was, however, some evidence of a serial correlation problem in equation [3]. This problem is likely the result of data reporting problems rather than either missing variables or inappropriate functional form. Since FNS must rely on records from the U.S. Treasury to verify its redemptions, little could be done to verify whether some of the variations in the monthly data were actually the result of reporting problems. This seems likely, though, since unusually large values in one month tended to be offset with unusually small values in the next. Attempts to reconcile the problem through the use of first differences were unsuccessful.

Results of equations [1], [2], and [3] provide a great deal of information about the coupon issuance, use, and redemption processes. Both the rate of unemployment and general increases in the food-price index exerted statistically significant positive influences on monthly stamp issuance, other things being equal. Stamp use apparently takes place in the month the stamps are issued. A $1 increase in issued stamps resulted in an approximately $1 increase in monthly grocery store to bank redemptions. While not statistically significant at the 0.05 level, increases in food sales during the month also positively influenced grocery store to bank redemptions.

The results of estimating equation [3], the Federal Reserve redemption model, indicate some statistical support for the hypothesis that there is a lag in the final redemption of some coupons. About 65 cents of each dollar deposited by grocery stores are actually redeemed by the Treasury in that same month. Another 32 cents of each dollar in coupons deposited are not reported as redeemed until the month following the deposit. *Ceteris paribus*, the banking system redeems approximately $20 million more coupons in those months in which there are 22 banking days (one more than the average 21).

The results of the estimation also indicate that bank deposits of the cash transfers, which result from existence of the purchase requirement, do occur without a lag. Over time, the purchase requirement has resulted in the collection of about 40 cents for each dollar in coupons issued. Statistical results, while explaining only about 80 percent of the total variation in cash deposits over time, do imply that for each $1 increase in current-month issuance, about 36 cents are deposited. The relatively low explained variation (R^2) partially reflects the rather erratic deposit pattern characteristic of the early years of the program. Since 1975, however, monthly cash deposits have been closely associated with current issuance (figure 4).

Equation [5], the Government liability equation, will be of particular interest now that the food stamp purchase requirement has been eliminated. This model may prove

Table 3--Models estimated to identify a lag structure in the stamp redemption process 1/

Dependent variable	Constant	Variables					R^2	F	S_y	D-W
		ISS	ISS_{t-1}	ISS_{t-2}	ISS_{t-3}	BA_t				
GS_t	24166705.42	1.02	--	--	--	-1967843.23	0.97	1167.80	29029478	2.79
		(48.32)**				(-.62)				
GS_t	12379388.53	.67	0.35	--	--	-1251024.89	.98	809.46	28489130	2.93
		(3.44)**	(1.83)			(-.40)				
GS_t	17297576.90	.69	.03	0.29	--	-1390188.74	.98	621.22	28176550	2.91
		(3.61)**	(.11)	(1.53)		(-.44)				
GS_t	3747284.66	.66	.06	.52	-0.21	-784360.08	.98	499.11	2812342	2.92
		(3.35)**	(.20)	(1.85)	(-1.11)	(-.25)				
R_t	-354639812.92	1.00	--	--	--	16730120.33	.95	838.08	44489521	3.23
		(40.73)**				(3.92)**				
R_t	-369695903.64	.41	.59	--	--	17703412.38	.95	560.58	43880001	3.18
		(1.43)	(2.06)*			(4.16)**				
R_t	-370851045.74	.40	.72	-.12	--	17741669.88	.95	399.07	44378552	3.19
		(1.36)	(1.69)	(-.43)		(4.12)**				
R_t	17965038.18	.39	.73	-.03	-.09	17965038.34	.95	302.87	44932285	3.18
		(1.26)	(1.65)	(-.07)	(-.28)	(4.06)**				
C_t	-72071104.44	.36	--	--	--	4439632.19	.77	140.25	39469319	2.02
		(16.70)**				(1.17)				
C_t	-74978115.99	.57	-.21	--	--	4630868.19	.77	89.56	39378603	2.07
		(2.24)*	(-.85)			(1.27)				
C_t	-74483277.82	.57	-.22	-.01	--	4650527.81	.76	63.17	39847309	2.06
		(2.18)*	(-.58)	(-.03)		(1.20)				
C_t	-77070862.12	.61	-.28	.12	-.09	4861776.85	.76	48.13	39985500	2.09
		(2.24)*	(-.73)	(.32)	(-.34)	(1.23)				

--Not applicable.

1/ Values in parentheses are t statistics. *Significant at the 95-percent level. **Significant at the 99-percent level.

Table 4--Summary of statistical results, food stamp redemption, 1970-77 1/

Equation	Statistical results
[1]	Coupon issuance $= -149{,}291{,}810. + \underset{(330{,}569)}{1{,}127{,}530.}\ (EMP_t) + \underset{(31{,}363)}{128{,}608.}\ (CPI_{f_t}) + \underset{(0.06)}{0.76}\ (ISS_{t-1})$
	$R^2 = .994,\ F = 4376.,\ DW = 1.7,\ \bar{Y} = \$469{,}672{,}162.,\ S_y = \$15{,}524{,}813.$
[2]	Grocery store redemption $= -39{,}319{,}180. + \underset{(0.05)}{0.98}\ (ISS_t) + \underset{(5.59)}{3.85}\ (FS_t)$
	$R^2 = .974,\ F = 1149.,\ DW = 2.6,\ \bar{Y} = \$529{,}950{,}182.,\ S_y = \$29{,}070.240.$
[3]	Federal Reserve redemption $= -420{,}397{,}037 + \underset{(0.13)}{0.65}\ (GS_t) + \underset{(0.13)}{0.32}\ (GS_{t-1}) + \underset{(5.660{,}762)}{20{,}896{,}977}\ (BA_t)$
	$R^2 = .924,\ F = 240.,\ DW= 3.11,\ \bar{Y} = \$538{,}391{,}207.,\ S_y = 51{,}165{,}845.$
[4]	Cash deposits $= -72{,}071{,}104. + \underset{(0.02)}{0.36}\ (ISS_t) + \underset{(3{,}785{,}646)}{4.439{,}632.}\ (BA_t)$
	$R^2 = .774,\ F = 140,\ DW = 2.02,\ \bar{Y} = \$190{,}662{,}741.,\ S_y = \$39{,}469{,}319.$
[5]	Government payments $= -335{,}198{,}660. + \underset{(0.29)}{0.32}\ (RB_t) + \underset{(0.28)}{0.68}\ (RB_{t-1}) + \underset{(7{,}257{,}018)}{16{,}360{,}888.}\ (BA_t)$
	$R^2 = .776,\ F = 67.,\ DW = 2.6,\ \bar{Y} = \$316{,}117{,}162.,\ S_y = \$65{,}245{,}686$

1/ Coefficient standard errors in parentheses.

Food Stamp Issuance and Cash Deposits

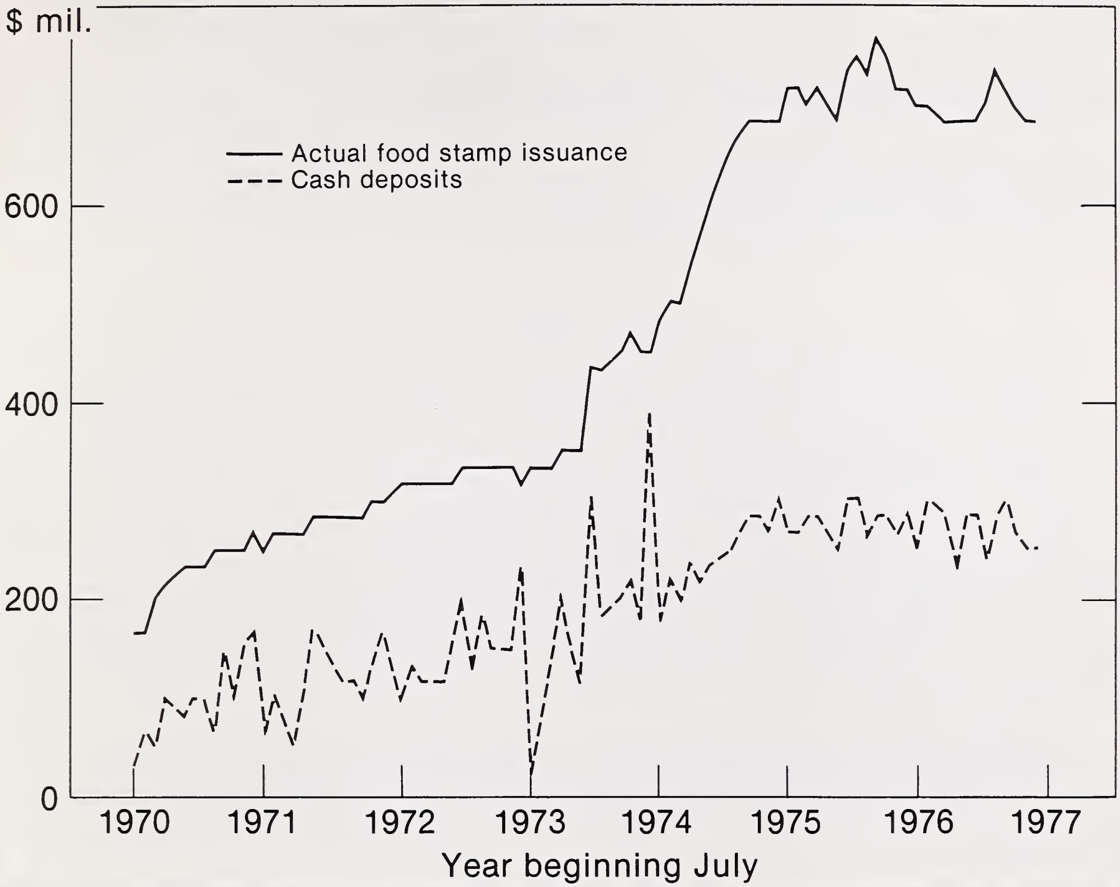

Figure 4

to be the one most useful in helping, ultimately, to monitor the food stamp redemption account. In addition, the model provides a partial test of the validity of the other statistical results. Assuming that the other results are indicative of actual program activity, it can be shown mathematically that bonus stamps issued in month t and in month t-1 should be included in the specification of an explanatory liability model. Further, it can be shown that current-month payments should increase by about 33 cents for each dollar of current-month bonus and about 67 cents for each dollar of bonus issued one month previously. These theoretical specifications cannot be rejected by the statistical results reported in table 4. The t tests, assuming that regression coefficients for RB_t and RB_{t-1} are, in fact, 0.33 and 0.67, respectively, do not permit rejection of the null hypothesis. As was the case in the other redemption model, equation [3], the number of banking days in the month exerted a statistically significant positive impact on the value of stamps redeemed.

FORECAST MODELS

Clearly, the information developed as a result of estimating the behavioral relationships discussed earlier would be helpful in forecasting the monthly variations in coupon redemptions by the Federal Reserve district banks. However, forecasting models require the explicit recognition of some constraints not binding when estimating explanatory models. Firstly, forecast models have to be reliable; that is, whether the coefficient estimates closely fit the theory is not nearly as important as having a model which, as a unit, tracks the variations in the variable of interest. Secondly, forecast models have to be developed in such a way that predictions for a specified month can be made in time to use the information in the decisionmaking process. This often requires the use of either lagged values for variables or values predicted from auxiliary equations. Finally, for this problem, the models have to be developed with a recognition that the level of redemptions would likely be different once the purchase requirement is actually eliminated as a part of the 1978 changes in program rules.

Since the models would be used for forecasting, many of the strict theoretical relationships expected in explanatory models would not have to be adhered to rigidly. For instance, the lag structures used would not have to be identical to those of the explanatory models. Nor would the variables necessarily have to be the same as long as the model is useful for forecasting.

Two statistical models were developed to forecast the monthly variations in food coupon redemptions. One model can be used to forecast the actual monthly requests for redemption. The second model was developed to help forecast the monthly variability in the Government liability implied by the stamp redemption process.

Making use of the information obtained in estimating the explanatory models, the forecast models were constructed to reflect the underlying behavioral relationships and still make use of data that is available in the months prior to the date of the needed forecast. The forecast models constructed permit the estimation of predicted values for: (1) issuance, (2) grocery store to bank redemptions, (3) Federal Reserve to Treasury redemptions, (4) cash deposits, and (5) Government payments.

These equations are solved sequentially. The first step in obtaining the estimate of Treasury redemptions is to estimate a value for stamp issuance in the current month t. The data needed for this equation include: (1) the value of stamp issuance for the previous month (ISS_{t-1}), (2) the CPI for food products 2 months prior to the current month ($CPI_{F_{t-2}}$), and (3) the level of domestic unemployment 2 months prior (EMP_{t-2}).

The overall solution of the five equations (i.e., a prediction for month t) only requires one additional piece of data--the number of banking days in the current month (BA_t). All other values are predicted once the issuance is determined. The first equation to be solved is then:

[6] $ISS_t = f(ISS_{t-1}, CPI_{F_{t-2}}, EMP_{t-2})$.

The predicted value for issuance determined by this equation will be denoted by $\overline{ISS}_t$. Likewise, all other predicted values used in the estimation of the equations will be superscripted by a bar.

Once a predicted value for issuance in month t is obtained, this value and the number of banking days in month, t, are used to obtain an estimate of the grocery store to bank redemptions in month, t. The second forecast equation is then:

[7] $GS_t = f(\overline{ISS}_t, BA_t)$.

The predicted value for grocery store to bank redemptions in month t is then used to complete the third link in the redemption chain--the movement of the food coupons from local banks to final redemption at a Federal Reserve district bank.

The model used to forecast the dollar value of these redemptions at the Federal Reserve differs slightly from its explanatory model counterpart. The substitution of predicted values for actual values of independent variables is evident. An additional problem, though, was encountered because the goal of this model is to forecast redemptions. The 1-month lag structure in the grocery store to bank redemptions, which is a theoretically and statistically sound variable in the explanatory model, unnecessarily complicates the predictive model. Since it does not contribute significantly to the model's predictive abilities, it is dropped from the Federal Reserve redemptions predictive model. This leaves the equation:

[8] $R_t = f(\overline{GS}_t, BA_t)$.

Value predictions for the monthly cash deposits are needed to make monthly predictions of the Government payments. Using the explanatory model as a reference point, the following forecast equation was developed for cash deposits:

[9] $C_t = f(\overline{ISS}_t, BA_t)$.

Using the predicted value of issuance in month t from equation [6] makes the equation parallel to those of earlier models.

As indicated in the earlier section on explanatory models, the model for Government payments can be developed algebraically using the results from estimating the other forecast models. By definition, monthly Government payments are equal to the difference between the actual requests for stamp redemptions and the cash deposits. That is:

Payments = redemptions - cash deposits.

From equations [8] and [9] we have:

Redemptions = (grocery store redemptions, banking activity), and
Cash deposits = (issuance, banking activity).

But, from equation [7]:

Grocery store redemptions = (issuance, banking activity).

So:

Redemptions = (issuance, banking activity).

Then, by substitution, we obtain:

Payments = (issuance, banking activity).

Once the purchase requirement is eliminated, the value of stamps issued will be reduced by approximately 40 percent (the proportion of the total value now being purchased). Only the bonus stamps will be issued. It is important, therefore, to develop a forecast equation that will be of some value once the program changes are implemented. To do that, the predicted issuance from equation [6] was adjusted by the amount of its cash payment value. At present, this represents about 60 percent of the total value. The Government liability forecast model therefore is:

[10] $P_t = f(\overline{B}_t, BA_t)$

where:

P_t = the dollar value of the Government food stamp liability in the current month, t (requests for redemption minus cash deposit),

$\overline{B}_t$ = the predicted value of bonus stamp issuance in month t (currently about 60 percent of the predicted issuance), and

BA_t = the number of banking days in the current month.

The results of the parameter estimation for the equations in the forecast models are shown in table 5. The results obtained for the forecasting models are remarkably consistent with those obtained when estimating the system of behavioral equations.

These models explain a significant percentage of the variation in their respective dependent variable vectors (table 5). There is little loss, in terms of predictive ability, when actual data are replaced by estimated values for independent variables. This substitution, of course, makes it possible to use the models for forecasting.

Figure 5 indicates how well the monthly redemption forecast equation tracks the historical monthly redemption values. In only two cases is the predicted redemption less than the actual by more than $100 million. In most cases, the error on the short side is quite small ($50 million or less). Such a result has important implications for determining the appropriate magnitude of the balance in the redemption account. If the equation had been used over the sample space to forecast monthly redemptions, and if monthly deposits had been made solely on the basis of the predicted redemption, maintenance of a monthly balance of about 25 percent of actual monthly redemption would have been more than sufficient to cover all model errors without generating a negative balance in the account.

Figure 6 shows the predicted values of the monthly Government liability relative to the actual values. There has been, as indicated, substantial month-to-month variability in this variable vector. While the independent variables do a reasonably good job of tracking the actual values, there are substantial errors in some months. The largest errors occur in June 1973, June and July 1974, and August, September, October, and November 1975. Model errors after that period are all substantially less than $75 million per month; these model errors are largely the result of year-end adjustments (primarily in cash deposits) or variations in monthly observations of either cash deposits or redemptions which are not explained by variables in the model. While the level of the Government liability has been closely associated with bonus stamp issuance over time, specific month-to-month values have been quite variable. Undoubtedly, some of this variation is due to unreconcilable data error.

Table 5--Statistical results of the parameter estimation for the forecast models 1/

Equation	Statistical results
[6]	Coupon issuance $= -106{,}198{,}081 + \underset{(3{,}615{,}777)}{503{,}006}\ (EMP_{t-2}) + \underset{(398{,}309)}{1{,}108{,}262}\ (CPI_{f_{t-2}}) + \underset{(.07)}{.82}\ (ISS_{t-1})$
	$R^2 = .993,\ F = 3{,}751,\ D\text{-}W = 1.63,\ \bar{Y} = 470{,}910{,}404,\ S_y = 16{,}407{,}378$
[7]	Grocery store redemption $= -21{,}024{,}023 + \underset{(.023)}{1.02}\ (\overline{ISS}_t) + \underset{(3{,}486{,}284)}{262{,}816}\ (BA_t)$
	$R^2 = .97,\ F = 974,\ D\text{-}W = 2.56,\ \bar{Y} = 529{,}950{,}182,\ S_y = 31{,}504{,}257$
[8]	Federal Reserve redemption $= -359{,}679{,}302 + \underset{(.025)}{.99}\ (GS_t) + \underset{(4{,}244{,}798)}{17{,}593{,}652}\ (BA_t)$
	$R^2 = .95,\ F = 815,\ D\text{-}W = 3.11,\ \bar{Y} = 468{,}088{,}772,\ S_y = 43{,}829{,}103$
[9]	Cash deposits $= -84{,}051{,}955 + \underset{(.023)}{.36}\ (\overline{ISS}_t) + \underset{(3{,}900{,}401)}{5{,}177{,}741}\ (BA_t)$
	$R^2 = .76,\ F = 122,\ D\text{-}W = 2.04,\ \bar{Y} = 193{,}656{,}365,\ S_y = 40{,}274{,}739$
[10]	Government payments $= -253{,}214{,}758 + \underset{(.05)}{.99}\ (B_t) + \underset{(5{,}694{,}280)}{12{,}130{,}617}\ (BA_t)$
	$R^2 = .82,\ F = 190,\ D\text{-}W = 2.71,\ \bar{Y} = 270{,}551{,}845,\ S_y = 59{,}116{,}847$

1/ Coefficient standard errors in parentheses.

Actual and Predicted Treasury Food Stamp Redemptions

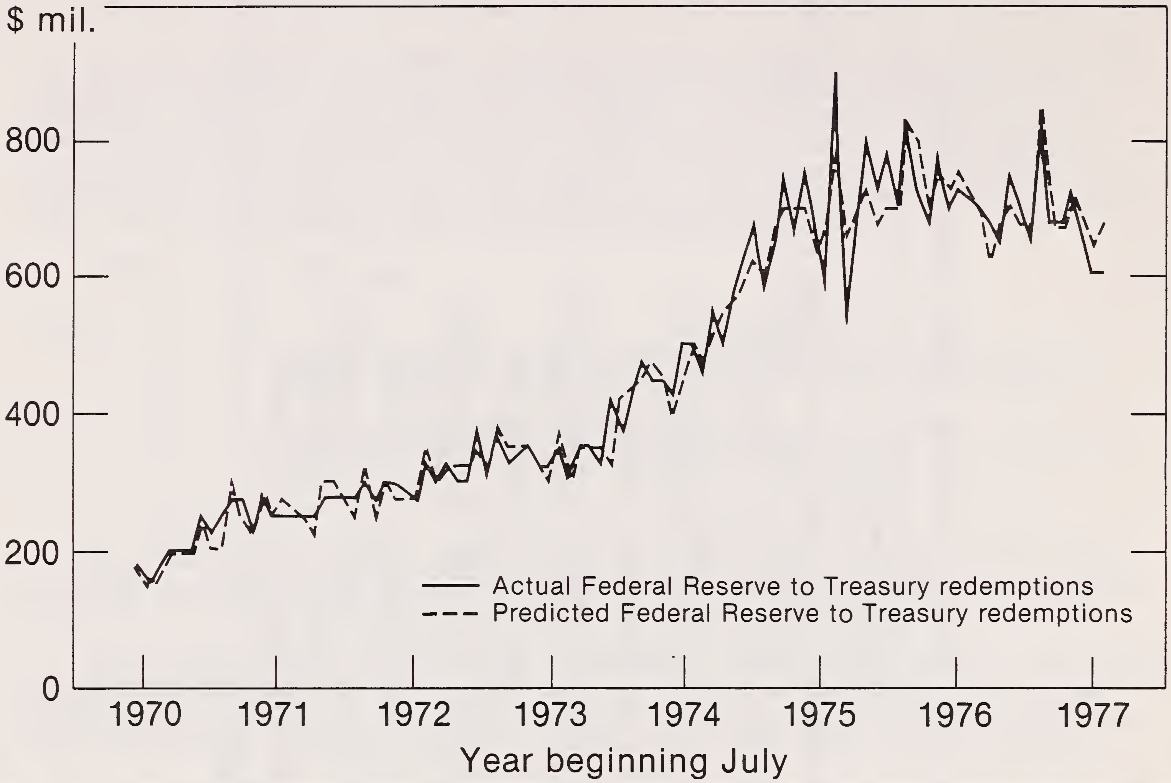

Figure 5

Actual and Predicted USDA Obligations

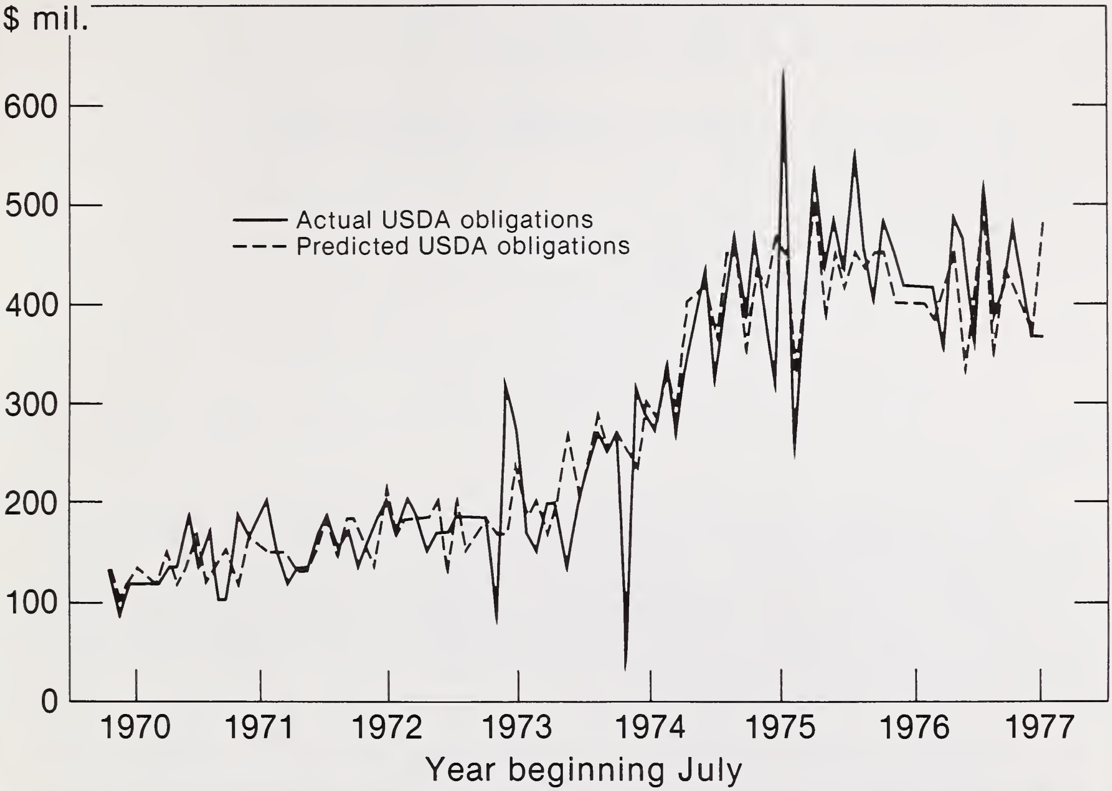

Figure 6

The numerical result of the liability model estimation is consistent with what is obtained if the Government liability is simply calculated as the difference between redemptions, equation [8], and cash deposits. That is:

$$R_t = 359{,}679{,}301 + 0.99\ \overline{GS}_t + 17{,}593{,}652\ BA_t \text{ and}$$

$$C_t = -84{,}051{,}954 + 0.36\ \overline{ISS}_t + 5{,}177{,}741\ BA_t$$

So:

$$P_t = -275{,}627{,}347 + 0.99\ \overline{GS}_t + 0.36\ (\overline{ISS}_t) + 12{,}405{,}911\ (BA_t).$$

But, since (from equation 7):

$$GS = -21{,}024{,}023 + 1.02\ (ISS_t) + 262.816(BA_t), \text{ then}$$

$$P_t = -296{,}411{,}129 + 0.66\ (\overline{ISS}_t) + 12{,}676{,}098\ (BA_t).$$

However, since bonus is about 60 percent of total issuance, then:

$$P_t = -296{,}411{,}129 + 1.10\ (B_t) + 12{,}676{,}098\ (BA_t).$$

This is very close to the result obtained through estimation and reported as equation [10].

The statistical consistency obtained through estimation of the forecast equations would appear to make the system a useful tool for more systematic monitoring of the food stamp redemption account. While the Government is technically liable for all stamps issued, the liability is not actually effected until the coupons are presented for payment by agents of the Federal Reserve. Explicit recognition of both coupon loss and the approximately 1-month lag in the redemption of some stamps would help to reduce the potential public liability for interest payments on short-term borrowed funds needed to finance the program.

The forecast model is designed to be relatively simple to use. Only four items of raw data are required each month. These data, together with the statistical results reported in this paper, make it possible to develop an estimate of Federal Reserve redemptions, cash deposits, and the Government liability on a monthly basis. The statistical results would appear to make such an effort worthwhile.

REFERENCES

Carmichael, Charlotte B., "The Food Stamp Program," Monthly Review. The Federal Reserve Bank of Richmond, Nov. 1968, pp. 8-10.

U.S. General Accounting Office, Food Stamp Receipts--Who's Watching the Money? CED-77-76. June 15, 1977.

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